Lava Beds National Monument

Teacher Information

Unit 2 Bat Adaptations

When looking at bat adaptations it is helpful to compare them to another mammal such as humans. A bat's body parts and anatomy are specialized and allow them to live in their unique habitats and eat different things than humans would. Each bat species has unique body structures which lets them gather, catch and eat different types of food, get water and find shelter.

Teeth:

Bats, like people, have teeth that they begin their life with called milk teeth, which they loose and replace with permenant teeth. Different species of bats have teeth that are adapted to the kind of food they eat.

Vampire bats have sharp front teeth which they use to bite an animal's skin. They then lick up the blood using grooves on their tongues to help move the blood (via capillary action) into its mouth. Since their liquid diet requires no chewing, vampire bats have only 20 teeth.



The sharp teeth of a vampire bat

Bats that feast on nectar usually have fewer teeth and some do not have teeth on the bottom at all, as they use their tongues to reach down into flowers for pollen and nectar. Bats that eat meat and insects usually have more teeth that are adapted to the type of food it eats.

Eyes:

Bats generally have eyes that are small or large. Their eye size determines how much they use their eyes for orientation. The majority of bats echolocate; this highly adapted sense of hearing allows bats to navigate and forage, often in total darkness. Bats that have smaller eyes do not rely heavily on their sense of sight to find their way. These bats cannot see in the dark, nor are they "blind as a bat". It is likely that most species use their sense of sight when light is available, however, the visual of acuity of each bat species is not well understood. To answer the question of "how well different species of bats can see", scientists are conducting laboratory studies that test the ability of the bat to perceive/discern different patterns and targets.

Bats with large eyes do not often have the ability to echolocate and are usually crepuscular (active dawn and dusk). Two examples of bats with large eyes are: Wahlbeg's epauletted fruit bat and the Lyle's flying fox. Other bats that eat fruit and nectar are nocturnal and also have larger eyes to help them see at night.

Nose:

Even though bats rely heavily on their other senses to get around and hunt, they do use their sense of smell to locate offspring. A mother bat can find her offspring in a crowd of over 20 million bats! One adaptation some bats have is a nose-leaf. A nose-leaf is a triangular piece of flesh that projects from the tip of their snouts, they are only found on bats that send out echolocation sounds through their noses. Nose-leafs appear to direct sound when the bat is using echolocation. One bat that has a nose-leaf is the California Leaf-nosed bat; it lives in southern

California, the very southern tip of Nevada and about half of Arizona. The Jamaican Leaf-nosed bat also has a nose-leaf and eats fruit. This adaptation allows the Jamaican Leaf-nosed bat to carry fruit in its mouth and echolocate at the same time.

Ears:

There are two major groups of bats, Megachiroptera (megabats) and Microchiroptera (microbats). Megabats all eat fruit or feed on flowers (nectar and pollen), this reduces their need for sophisticated echolocation. The two species of megabats are known to use echolocation by simply clicking their tongues much like a human would click its tongue. Echolocation is also used by microbats, however, megabats are more reliant on their eyes than their ears as opposed to microbats.

Sounds which microbats use to echolocate are created by vocalizing with their larynx (those

species that have a nose-leaf appear to direct sound with this facial attribute). Echolocation consists of two parts, creating sound and "catching" sound. First the bat emits a sound wave – frequently called "chirping" – then the bat uses its ears to "catch" the sound after the sound bounces off of an object (this is visually demonstrated in the video). Bats that use echolocation usually have large cupped ears which allow them to have very sensitive hearing. The

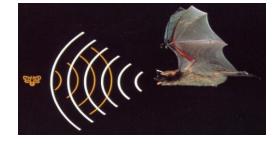


diagram shows a sound wave being emitted by bat (white) and then bouncing back to bat (orange).

Bats that hunt at night use echolocation to find their prey. This also gives bats an advantage when hunting, since some of the insects that bats eat are only active at night such as moths, this means the bat does not have to compete with other daytime animals such as birds for food. Bats not only use echolocation to hunt, they use it to navigate in the dark as well. This allows them to be able to use dark places like caves as homes. Other animals that use echolocation are: dolphins, whales and shrews.

One way of describing how big cupped ears hear better is to have students listen to a whisper, with their eyes closed. Then have them cup their hands behind their ears, and with their eyes still closed listen again to a whisper, an improvement should be noticed. An easy way to explain the sound waves bouncing back is by comparing it to bouncing a ball off the floor and having it come directly back to your hand. When the bat hears the "reflected" sound the bat can figure out where objects are. One adaptation found in many species of bats which echolocate is the tragus. This tiny sword shaped piece of flesh is located in the ear. This structure is believed to aid in echolocation and is frequently used as a defining characteristic when scientists are identifying species.

Why don't we hear bats' chirps? Bats make very high pitched sounds that are outside human hearing range, usually 20 hertz to 20,000 hertz. Bats emit sounds in the range of 21,000 hertz to 51,000 hertz. While adults usually cannot hear sounds made by a bat, sometimes younger people or those who have exceptional hearing are able to hear bat chirps. Another example of this is a dog whistle, people cannot hear the whistle, but dogs that have a larger range of hearing can.

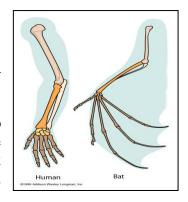
Neck:

Bats are able to look towards their backs while hanging upside down. Imagine yourself hanging upside down and being able to look all the way behind you easily! Bats have special vertebrae

which allow them this amazing flexibility. This is useful because bats hang upside down from their feet.

Hands/Arms/Fingers:

While both people and bats have arms and five fingers, bats fingers are much longer than our fingers and they are connected with a membrane, forming the wing. For our fingers to be as long as bats' fingers our fingers would have to go all the way down to our ankles. By having their arms and fingers connected by skin a bat is able to fly. This offers escape from predators, and the ability to capture prey or fly between fruit trees. Similar to our thumbs, a closer look at a bat thumbs' reveals that they are shorter than their fingers and are used as hooks to move around on cave ceilings.



Tailbone:



Unlike humans' short tailbone, some bats have a long tailbone that is attached with a large membrane. If this adaptation is present the bat is usually an insect eating bat. This membrane allows the bat to capture insects like a butterfly net. Some bats also use their tail to help them steer while they are hunting insects. Bats that do not hunt usually have shorter tails and the tail membrane is smaller or absent.

perch claw tendon phalanx

Feet/Claws:

While hanging upside down a bats grasp is closed when muscles are relaxed. This allows bats to occupy space predators cannot reach, take off easily, and raise their young in the warmer temperatures which exists near ceiling domes. Some bats use their feet and razor sharp claws to catch fish or newly hatched insects from a water surface.

Their feet also have a special "hinge" that tightens when weight is added to the claw. When a bat is at rest, its entire body weight hangs suspended from its toes. This diagram shows that bat feet are designed very differently from those of humans. When the bat's weight pulls down on the tendon, the claw clenches more tightly over the perch. The ratchet is a rough sheath that holds the tendon in place after it is pulled down, so the bat doesn't have to do any work to keep its toes curled, unlike us! When the bat takes off in flight, the tension on the tendon is released, and the claw releases

its hold. This tendon-locking mechanism works so well that bats may remain hanging from a perch even after they have died.

Some bats have feet which are very specific to the type of food they eat. Fish eating bats, like

the bulldog bat, have very large feet that they use to catch fish.

